CLAIMS

I claim:

1. A vehicle weight classification system comprising:

a seat assembly having a seat frame for supporting a seat bottom;

a seat belt assembly for securing a seat occupant to said seat assembly;

a plurality of weight sensors mounted to said seat frame for generating a plurality of weight signals in response to a weight force applied to said seat bottom;

at least one seat belt force sensor for generating a seat belt force signal;

an electronic control unit for receiving said weight signals and seat belt force signals to determine occupant weight and center of gravity, generating an occupant classification based on said occupant weight and center of gravity, and transmitting an output control signal based on said occupant classification; and

an airbag module for receiving said output control signal to control airbag deployment based on said occupant classification.

2. A system according to claim 1 wherein said seat assembly includes a seat mount for attachment to a vehicle floor and said plurality of weight sensors comprises a first sensor mounted at a front right side corner of said seat bottom between said seat frame and said seat mount, a second sensor mounted at a front left side corner of said seat bottom between said seat frame and said seat mount, a third sensor mounted at a rear right side corner of said seat bottom between said seat frame and said seat mount, and a fourth sensor mounted at a rear left side corner of said seat bottom between said seat frame and said seat mount.

3. A system according to claim 2 wherein said plurality of weight signals comprises a first weight signal generated by said first sensor, a second weight signal generated by said second sensor, a third weight signal generated by said third sensor, and a fourth weight signal generated by said fourth sensor, said first and second weight signals being combined to produce a front weight portion signal and said third and fourth weight signals being combined to produce a rear weight portion signal wherein said front and rear weight portion signals are compared to each other to determine said center of gravity.

4. A system according to claim 3 wherein said front and rear weight portion signals are combined to produce an initial seat occupant weight and wherein said electronic control unit modifies said initial seat occupant weight based on said seat belt force signal and said center of gravity to produce a final seat occupant weight, said output control signal being generated based on said final seat occupant weight.

5. A system according to claim 2 wherein each of said weight sensors includes a bending element mounted between said seat frame and said seat mount, at least one strain gage assembly mounted on said bending element, and an integrated electronics package for electrically connecting said strain gage to said electronic control unit.

6. A system according to claim 5 wherein said electronics package includes flexible printed circuit board mounted to said bending element and an application specific integrated circuit supported by said bending element for conditioning said weight signal.

7. A system according to claim 5 wherein said bending element includes a first end mountable to said seat frame, a second end mountable to said seat mount, and a bendable center portion having an upper surface and a lower surface wherein a groove is formed in one of said upper or lower surfaces extending along the width of said bending element to localize strain in said bendable center portion.

8. A system according to claim 7 wherein said strain gage assembly is mounted on the other of said upper or lower surfaces, facing opposite from said groove.

9. A system according to claim 5 wherein said electronic control unit includes a power regulator connectible to a power source, a microprocessor for analyzing said weight signals and said seat belt force signals, and a communication bus for interacting with said airbag control module.

10. A system according to claim 9 wherein said electronic control unit includes a plastic housing having integrated insert molded sealed connectors for connection to said power source and said electronics package.

11. A system according to claim 9 including a series of weight class data storable in said electronic control unit wherein each weight class has an upper threshold and a lower threshold wherein said microprocessor for generates an estimated weight signal based on the combination of said plurality of weight signals, compares said estimated weight signal to said upper and lower thresholds to assign said signal an appropriate weight class designation, and locks said estimated weight signal into an occupant specific weight class when a predetermined number of consistent and consecutive weight class designations is achieved.

12. A system according to claim 2 wherein said seat belt assembly includes a rigid member having a first end for supporting a seat belt portion and a second end for attachment to a vehicle structure and wherein said at least one seat belt force sensor comprises at least one strain gage assembly mounted on said rigid member between said first and second ends for measuring the strain exerted on said rigid member by a tension force applied to said seat belt portion.

13. A system according to claim 12 including an electrical connector mounted to said rigid member adjacent to said strain gage for receiving strain measurements from said strain gage and transmitting said measurements to said electronic control unit to determine the magnitude of the tension force.

14. A system according to claim 13 wherein said rigid member includes a neck portion positioned between said first and second ends having a width that is less than the width of said first and second ends and wherein said strain gage is mounted on said neck portion.

15. A system according to claim 14 wherein said first end includes an elongated slot for a loop attachment to said seat belt portion and said second end includes at least one aperture for receiving a fastener for attachment to the vehicle structure and wherein said electrical connector is mounted to said rigid member adjacent to said second end between said aperture and said neck portion.

16. A method for classifying a seat occupant into a weight class comprising the steps of:

(a) measuring a weight force of a seat occupant exerted against a seat bottom to generate a weight signal;

(b) measuring a seat belt force generated by securing the seat occupant to a vehicle seat with a seat belt assembly to generate a seat belt force signal;

(c) determining center of gravity of the seat occupant based on said weight signal;

(d) classifying the seat occupant into a predetermined weight classification based on said weight and seat belt force signals;

(e) generating an output control signal based on seat occupant classification; and

(f) controlling deployment of a safety device based via the output control signal.

17. A method according to claim 16 wherein step (d) includes

(d1) generating an estimated weight based on the weight signal;

(d2) comparing the estimated weight to a series of weight classes each having at least one weight class threshold to determine an individual classification sample;

(d3) repeating steps (d1) and (d2) until a predetermined number of individual classification samples having the same value is achieved;

(d4) locking the individual classification sample as the occupant weight class; and

(d5) generating an occupant weight class signal.

18. A method according to claim 17 further including the steps of

(d6) unlocking the individual classification sample when a predetermined number of non-equal individual classification samples is achieved; and

(d7) returning to step (a) when step (d6) is satisfied.

19. The method according to claim 18 wherein step (d2) further includes assigning each weight class an upper threshold and a lower threshold, comparing the estimated weight to the upper and lower thresholds for the last known weight class, and setting the individual classification sample equal to the last known weight class if the estimated weight is between the upper and lower thresholds for the last known weight class.

20. The method according to claim 19 including the step of setting the individual classification sample equal to a next higher weight class if the estimated weight is greater than the upper threshold for the last known weight class or setting the individual classification sample equal to a next lower weight class if the estimated weight is less than the lower threshold for the last known weight class.

21. The method according to claim 20 including the steps of increasing the value of the upper threshold of the individual classification sample by a first predetermined amount and decreasing the value of the lower threshold of the individual classification

sample by a second predetermined amount once the individual classification sample is locked.

22. The method according to claim 20 including the steps of decreasing the value of the upper threshold of the individual classification sample by a first predetermined amount and increasing the value of the lower threshold of the individual classification sample by a second predetermined amount after the individual classification sample is unlocked.

23. The method according to claim 18 including the steps of

providing a track mode having a first set of thresholds for each of the weight classes and a lock mode having a second set of thresholds for each of the weight classes that is different than the first set of thresholds; and

determining whether the method is in the track mode or the lock mode prior to step (d2).

24. The method according to claim 23 including the step of providing the first set of thresholds with an upper track threshold and a lower track threshold for each of the weight classes and providing the second set of thresholds with an upper lock threshold having a value greater than the upper track threshold and a lower lock threshold having a value less than the lower track threshold.

25. The method according to claim 24 including the step of beginning in the track mode, initiating the lock mode when a predetermined number of consistent and consecutive individual classification samples is achieved, and moving from the lock mode to the track mode when a predetermined number of inconsistent individual classification samples is achieved.

26. The method according to claim 18 wherein step (d6) further includes waiting at least five seconds before unlocking the individual classification sample.

27. The method according to claim 17 including the step of filtering out momentary events prior to step (d4).

28. The method according to claim 27 wherein step (d3) further includes repeating steps (d1) and (d2) for at least five seconds prior to locking the individual classification sample.

29. The method according to claim 17 including the step of updating weight class determination at least one time per second prior to locking the individual classification sample.

30. The method according to claim 17 wherein step (a) further includes

mounting a first sensor at a right front portion of the seat bottom to generate a right front weight signal;

mounting a second sensor at a left front portion of the seat bottom to generate a left front weight signal;

mounting a third sensor at a right rear portion of the seat bottom to generate a right rear weight signal;

mounting a fourth sensor at a left rear portion of the seat bottom to generate a left rear weight signal; and

generating the estimated weight based on the right front, left front, right rear, and left rear weight signals.

31. The method according to claim 30 wherein step (c) further includes combining the right front and left front weight signals to generate a front weight portion signal and combining the right rear and left rear weight signals to generate a rear weight portion signal, and comparing the front and rear weight portion signals to each other to determine the center of gravity.

32. The method according to claim 31 including the step of generating a first weight compensation factor based on the seat belt force signal.

33. The method according to claim 32 including the steps of generating a second weight compensation factor based on the center of gravity and adjusting the estimated weight via the first and second weight compensation factors to determine an adjusted seat occupant weight.

34. The method according to claim 33 wherein the adjusted seat occupant weight is determined prior to locking the individual classification sample.